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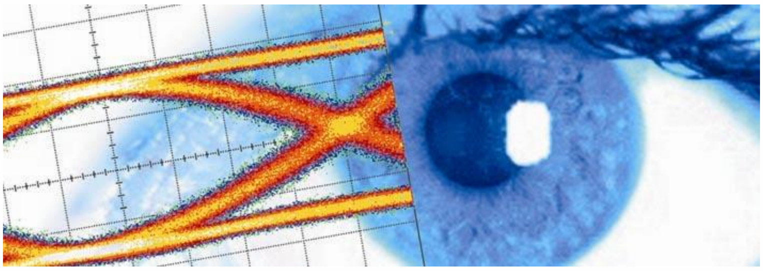
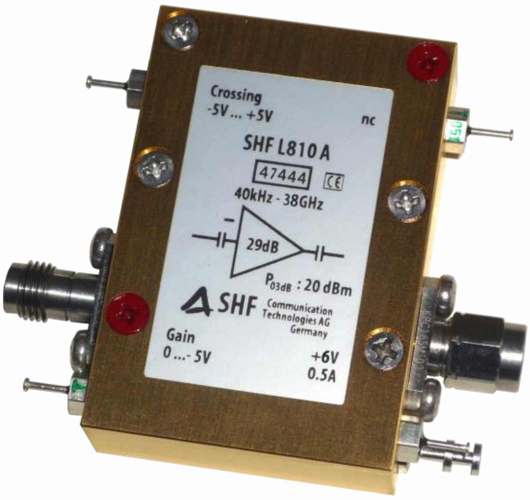


Datasheet

SHF L810 A

Broadband Linear Amplifier



Description

The SHF L810 A is the RoHS compliant successor to the popular SHF 810 driver amplifier.

The L810 A is a three-stage amplifier design, using proprietary monolithic microwave integrated circuits (MMICs) inside special carriers to achieve ultra-wide bandwidth and low noise performance. An internal voltage regulation protects the amplifier against accidental reverse voltage connection and makes it robust against line voltage ripple.

Ease of Use

Upon delivery, the amplifier is already pre-set to deliver maximum gain, maximum output amplitude and nominally 50% crossing. The gain could be reduced by applying a negative voltage to the Gain control pin. By applying a positive or negative voltage to the Crossing control pin the Crossing could be adjusted. For more detailed information see page 10.

Available Options

01: DC return on input (max. ±1.75 V, max. 35 mA)[1]

02: Built-in bias tee on input (max. ±9 V, max. 200 mA)[1]

03: DC return on output (max. ±1.75 V, max. 35 mA)[1]

04: Built-in bias tee on output (max. ±9 V, max. 200 mA)[1]

MP: Matches the phase of two amplifiers

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[1] The options 01 & 02 or 03 & 04 cannot be combined.
If an option is chosen, maximum gain and output power might be reduced by up to 1 dB and the low frequency 3 dB point might be increased up to 70 kHz. The DC resistance of a bias tee is about 4 Ω.

Specifications – SHF L810 A

Parameter	Unit	Symbol	Min	Typ	Max	Conditions
Absolute Maximum Ratings						
Maximum RF Input Power in Operation	dBm V	$P_{in\ max}$			0 0.63	 peak to peak voltage
Maximum RF Input Power without Power Supply	dBm V	$P_{in\ max}$			10 2	 peak to peak voltage
DC Voltage at RF Input	V				±9	AC coupled input
DC Voltage at RF Output	V				±9	AC coupled output
Gain Control Voltage	V		-6	-5…0	+6	will not exceed 0.03 A
Crossing Control Voltage	V		-6	-5…+5	+6	will not exceed 0.03 A
Supply Voltage	V		5.2	6	7	0.4 A, reverse voltage protected
Case Temperature[2]	T_{case}	°C	10	45	55	

[2] If operated with heat sink (part of the delivery) at room temperature there is no need for additional cooling.

Parameter	Unit	Symbol	Min	Typ	Max	Conditions
Electrical Characteristics (At 45°C case temperature, unless otherwise specified)						
High Frequency 3 dB Point	GHz	f_{HIGH}	38			
Low Frequency 3 dB Point	kHz	f_{LOW}			40	
Gain	dB	S_{21}	28	29		inverting measured at P_{in}=-27 dBm
Max. Gain Reduction	dB		2	3	4	
Output Power at 1 dB Compression	dBm V	P_{01dB}	17 4.5			10 MHz…20 GHz peak to peak voltage
Output Power at 2 dB Compression	dBm V	P_{02dB}	18.5 5.3			10 MHz…20GHz peak to peak voltage
Output Power at 3 dB Compression	dBm V	P_{03dB}	19.5 6			10 MHz…20 GHz peak to peak voltage
Crossing Control Range	%		-7		7	at 6 Vpp
Input Return Loss	dB	S_{11}		-12 -10	-10 -9	< 10 GHz < 35 GHz
Output Return Loss	dB	S_{11}		-10	-9	< 35 GHz
Rise Time/Fall Time	ps	tr/tf			11 15	20%...80% Deconvoluted[3,4] Full Setup[3]
Jitter	fs	JRMS		600 700	720 800	Deconvoluted[3,4] Full Setup[3] measured at 44 Gbps / 6 Vpp
Group Delay Ripple	ps				±50	2 GHz…30 GHz, 160 MHz aperture
Power Consumption	W			2.4		6 V / 0.4A
Mechanical Characteristics						
Input Connector						1.85 mm (V) female[5]
Output Connector						1.85 mm (V) male[5]

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[3] Measured with SHF BPG 40 A (at full scale) -> DUT (SHF L806 A) -> Agilent 86100C with 70 GHz sampling head & precision time base.

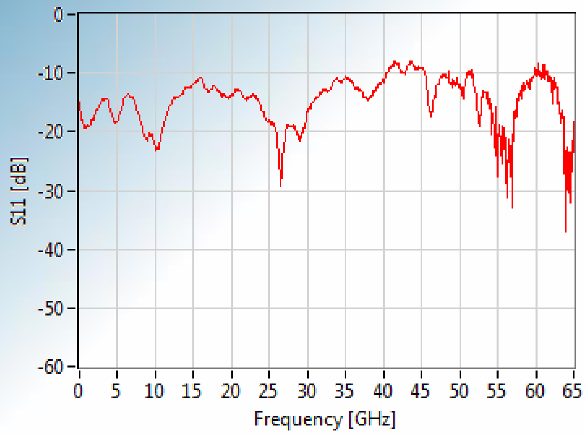
[4] Calculation based on typical results of setup without DUT :

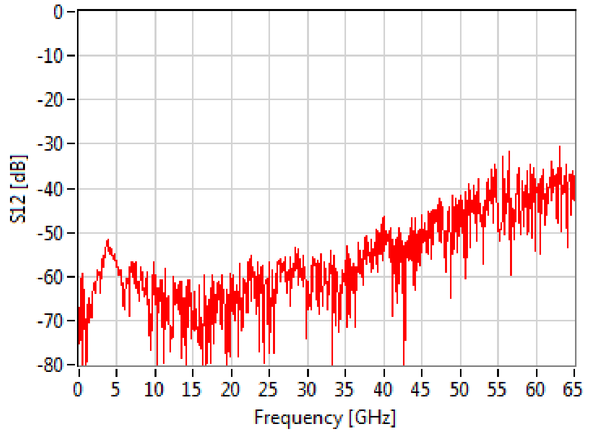
$$t_{r\ deconvoluted} = \sqrt{(t_{r\ full\ setup})^2 - (t_{r\ setup\ w/o\ DUT})^2} = \sqrt{(t_{r\ full\ setup})^2 - (11\ ps)^2}$$

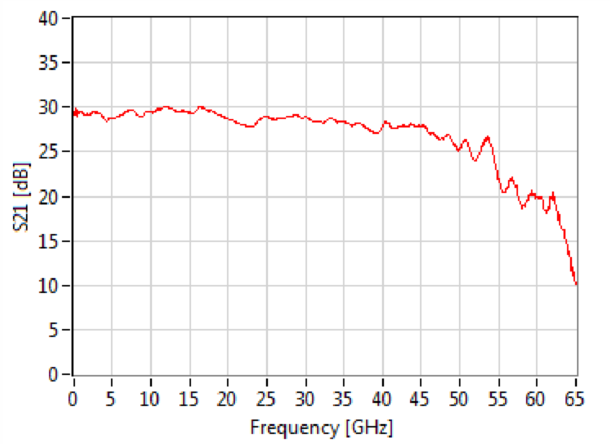
$$J_{RMS\ deconvoluted} = \sqrt{(J_{RMS\ full\ setup})^2 - (J_{RMS\ setup\ w/o\ DUT})^2} = \sqrt{(J_{RMS\ full\ setup})^2 - (350\ fs)^2}$$

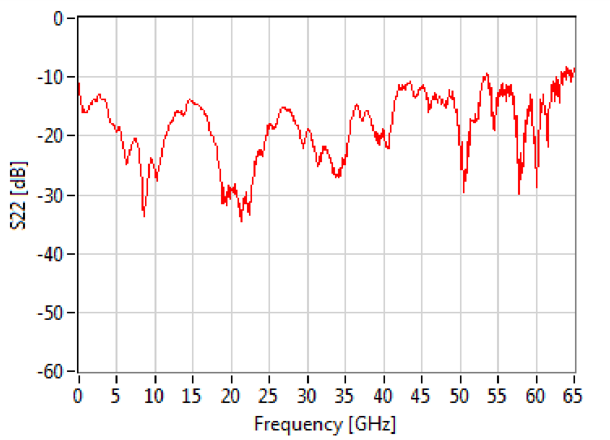
[5] Other gender configurations are available on request.

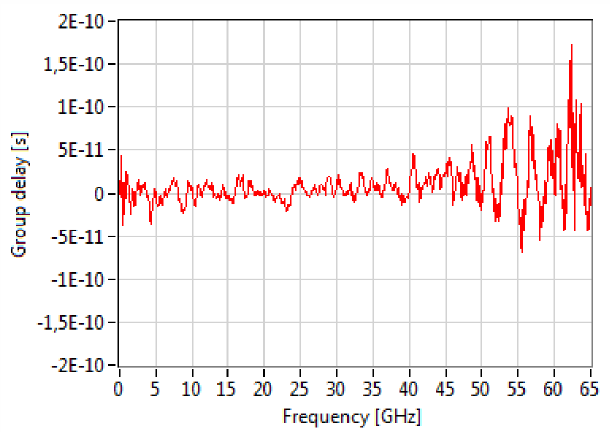
Typical S-Parameters, Group Delay and Phase Response

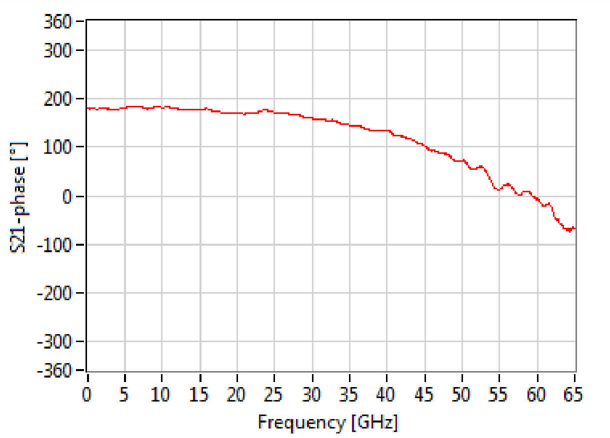








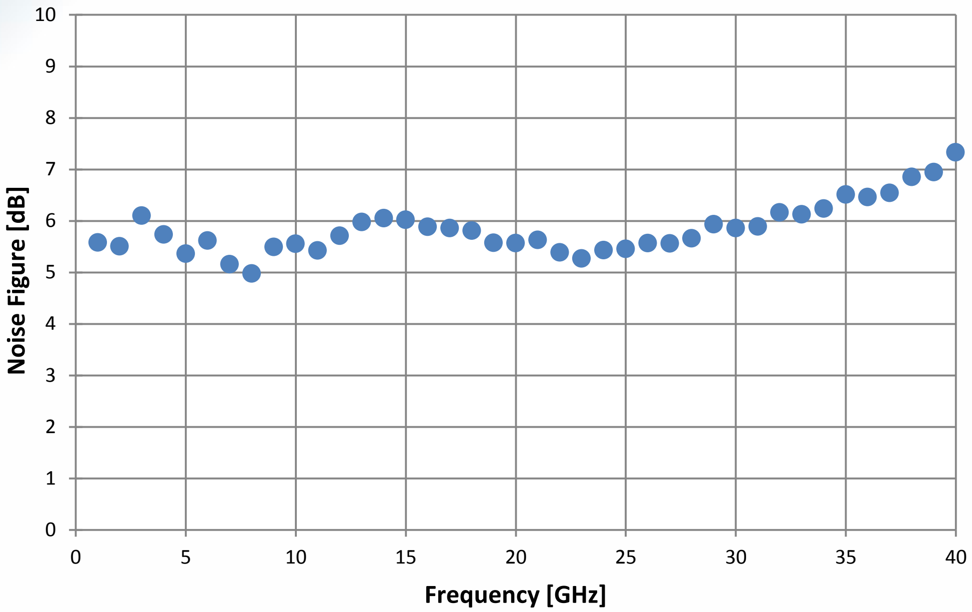




Aperture of group delay measurement: 160 MHz

Typical Noise Figure

The measurement had been performed using a FSW85 Spectrum Analyzer by Rhode & Schwarz. The noise figure defines the degradation of the signal-to-noise ratio when the signal passes the amplifier. An ideal amplifier would amplify the noise at its input along with the signal. However, a real amplifier adds some extra noise from its own components and degrades the signal-to-noise ratio. Please note that this applies to small signals only. When the amplifier is used close to or in its saturation region additional non-linear effects will impact the signal-to-noise ratio and the signal waveform.

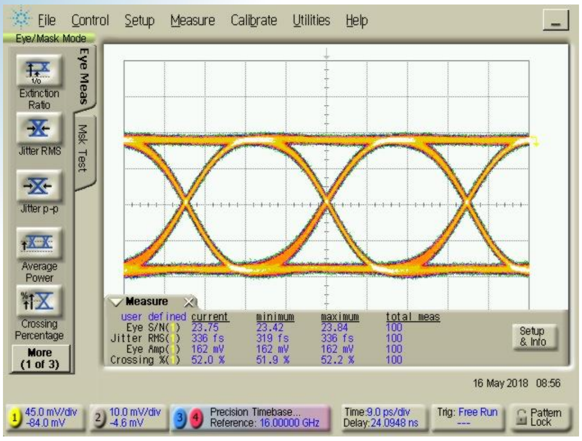


Typical Binary Waveforms

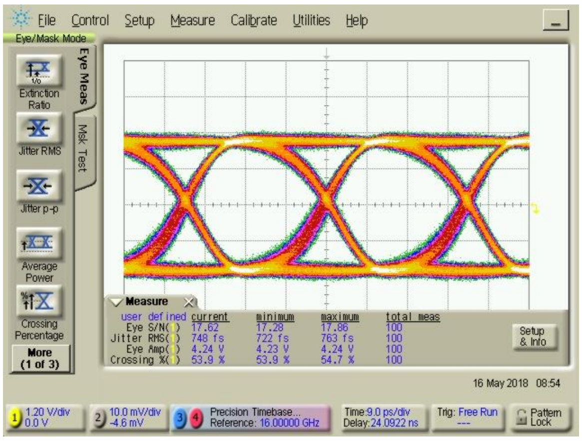
Eye Amplitudes: Input ~150 mV ⇒ Output ~4 V

Measurements at 32 and 44 Gbps had been performed using a SHF 40 A BPG and an Agilent 86100C DCA with Precision Time Base Module (86107A) and 70 GHz Sampling Head (86118A).

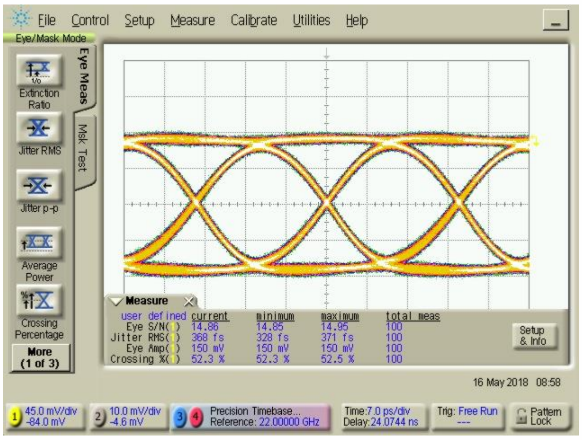
This measurements will not be part of the inspection report delivered with each particular device.



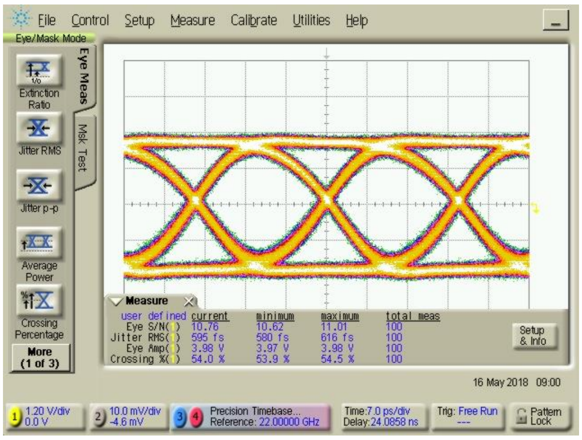
Input Signal @ 32 Gbps



Output Signal @ 32 Gbps



Input Signal @ 44 Gbps



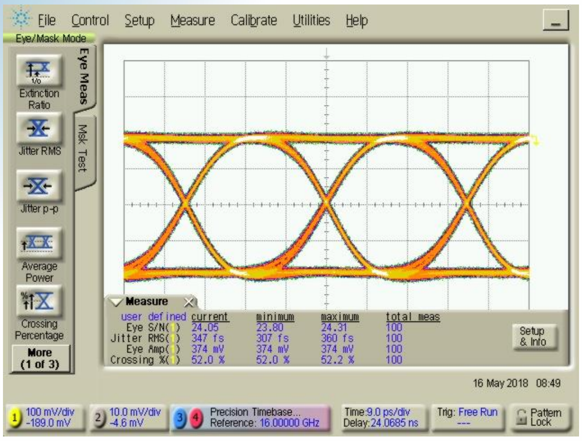
Output Signal @ 44 Gbps

Typical Binary Waveforms

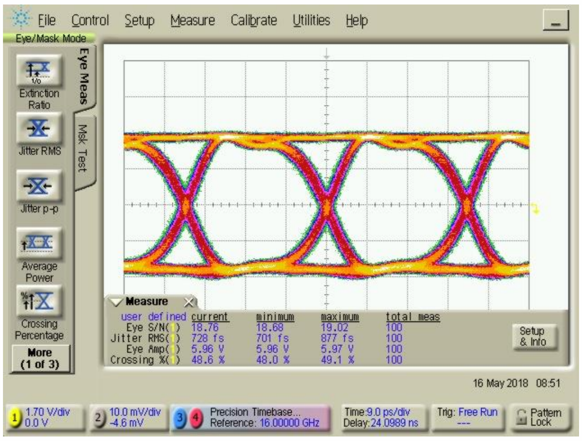
Eye Amplitudes: Input ~350 mV ⇒ Output ~6 V

Measurements at 32 and 44 Gbps had been performed using a SHF 40 A BPG and an Agilent 86100C DCA with Precision Time Base Module (86107A) and 70 GHz Sampling Head (86118A).

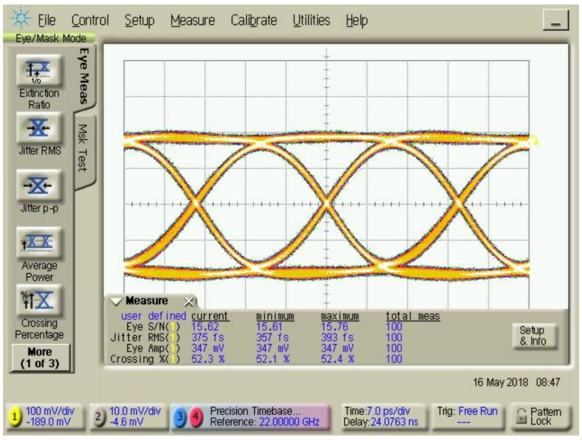
This measurements will be part of the inspection report delivered with each particular device.



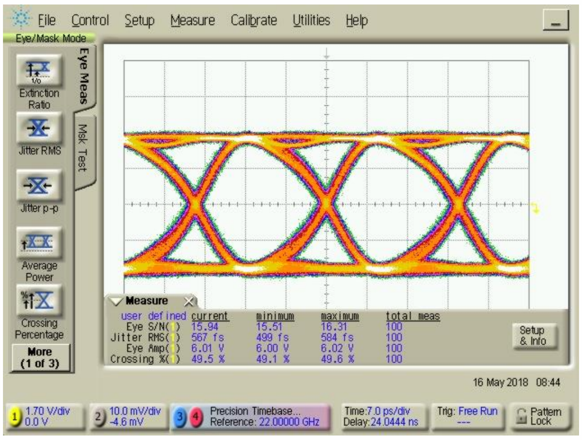
Input Signal @ 32 Gbps



Output Signal @ 32 Gbps



Input Signal @ 44 Gbps



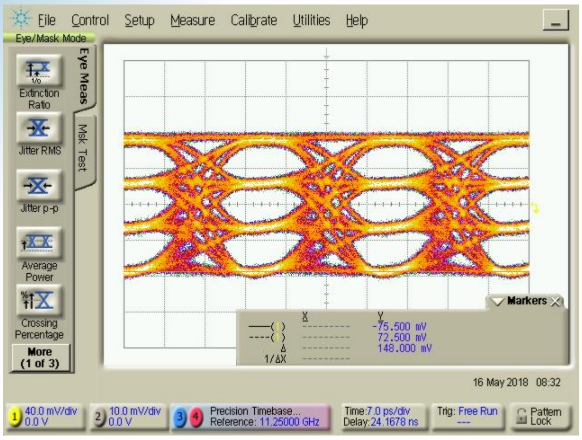
Output Signal @ 44 Gbps

Typical 4-Level Waveforms

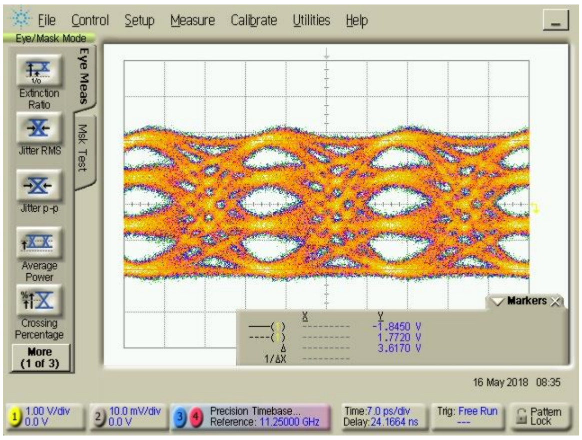
Eye Amplitudes: Input ~150 mV ⇒ Output ~3.5 V

Measurements had been performed using a SHF 613 A DAC and an Agilent 86100C DCA with Precision Time Base Module (86107A) and 70 GHz Sampling Head (86118A).
-5 V applied to the crossing control pin.

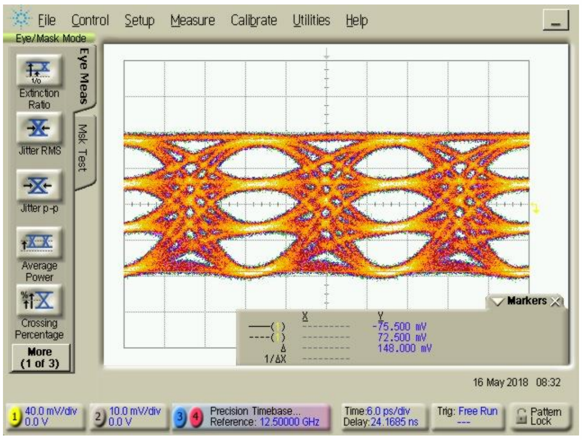
This measurements will not be part of the inspection report delivered with each particular device.



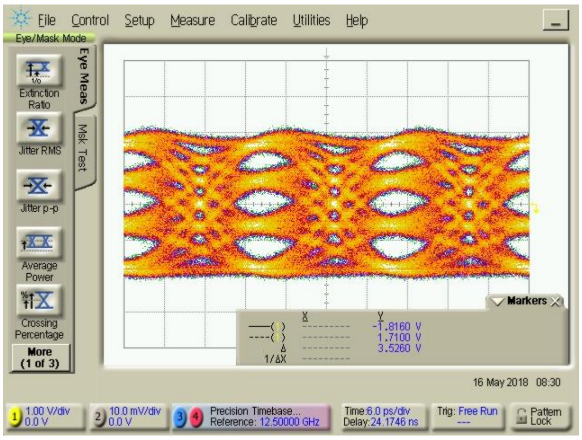
Input Signal @ 45 GBaud



Output Signal @ 45 GBaud, ~3.5 Vpp



Input Signal @ 50 GBaud

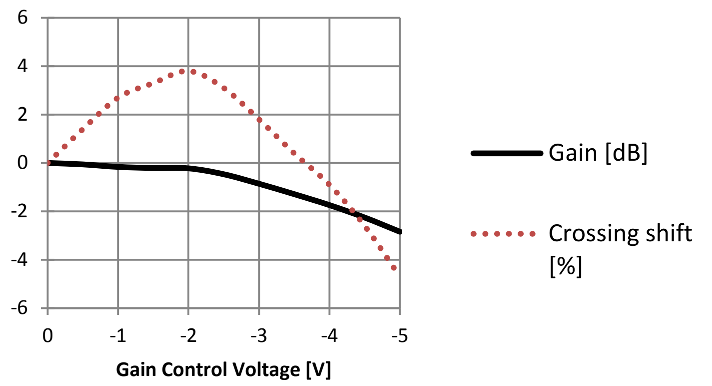


Output Signal @ 50 GBaud, ~3.5 Vpp

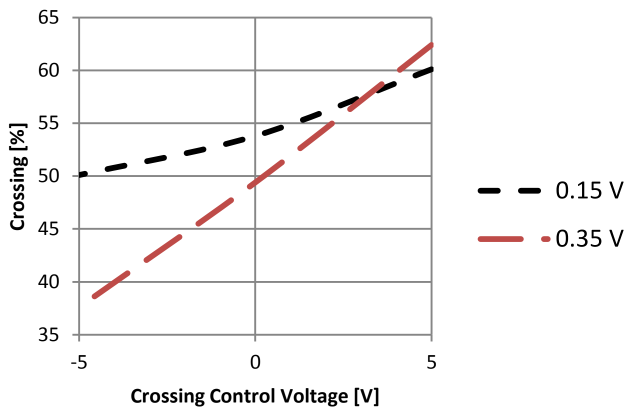
Handling Instructions

To operate the amplifier a positive supply voltage of approximately +6 V must be applied.

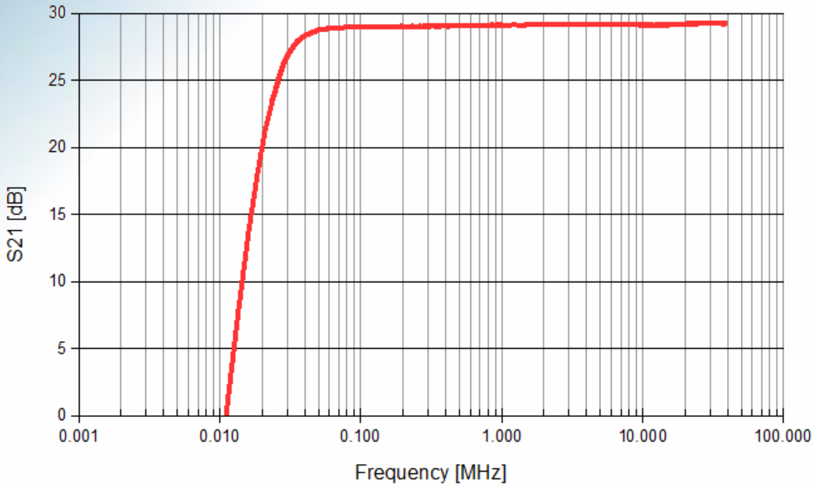
The gain can be adjusted by applying a voltage of 0 to -5 V to the gain control pin. If this pin is left open, the amplifier will have maximum gain. By reducing the gain the crossing will shift. Typical characteristics are shown in the following diagram for an input voltage of 0.35 Vpp with 50% crossing.



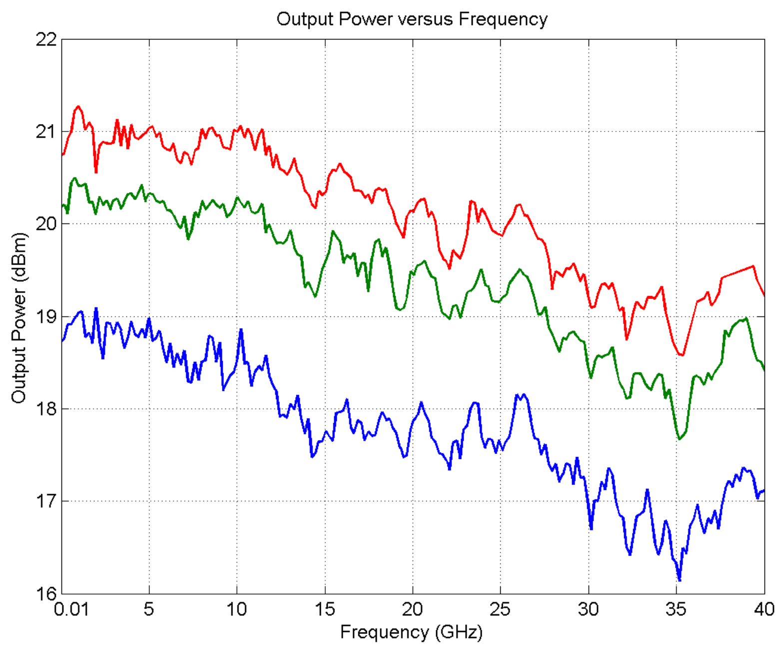
The crossing can be adjusted by applying a voltage of -5 to +5 V to the crossing control pin. If this pin is left open a crossing of approximately 50 % is achieved. The range depends on the input voltage level. Typical characteristics are shown in the following diagram for input voltages of 0.15 and 0.35 Vpp with 50% crossing.



Typical Low Frequency Response (<40 MHz)

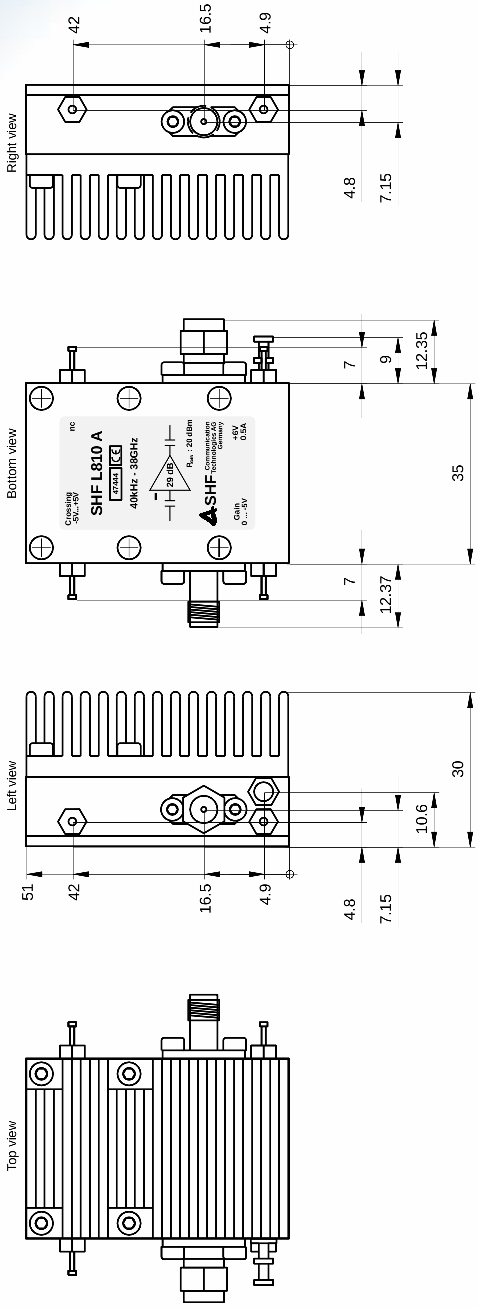


Typical Saturation power



Top (red): 3 dB compression;
Middle (green): 2 dB compression;
Bottom (blue): 1 dB compression

Mechanical Drawing with Heat Sink

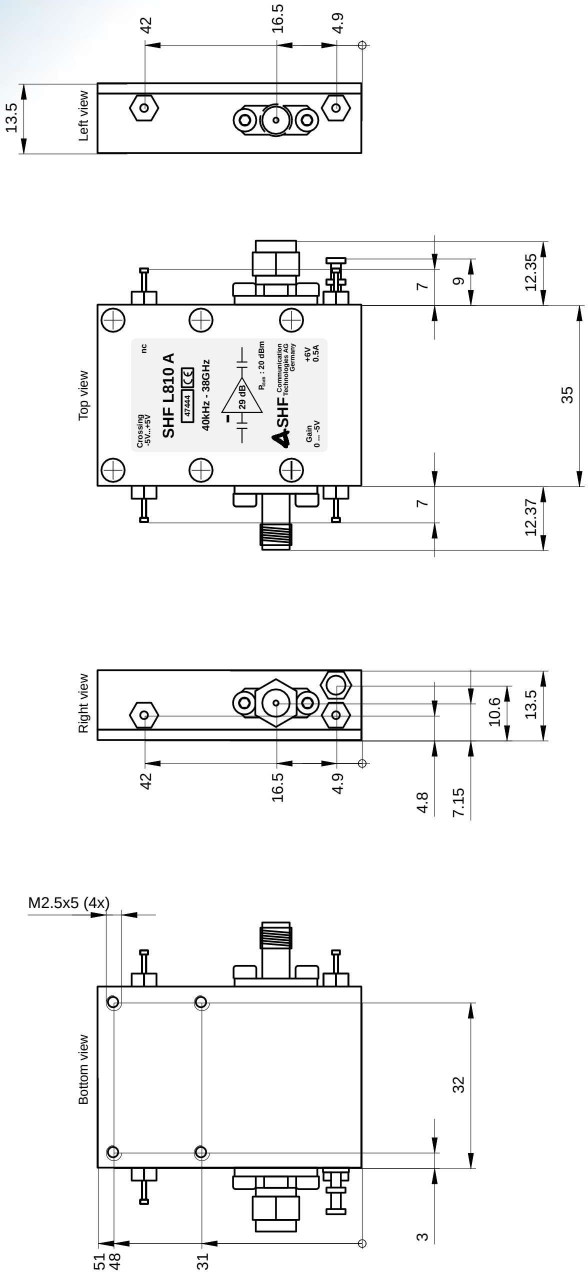


All dimensions in mm

Pin assignment might change if a bias tee option is chosen.

For permanent mounting remove the heat sink from the amplifier. In that case please ensure that adequate cooling of the amplifier is guaranteed. It is recommended to use thermal paste or a thermal gap pad for the mounting. In order to separate the heat sink from the amplifier, remove the four screws on the heat sink. Please note, thermal paste is used between the heat sink and the amplifier housing.

Mechanical Drawing without Heat Sink



All dimensions in mm

Pin assignment might change if a bias tee option is chosen.

Please ensure that adequate cooling of the amplifier is guaranteed.

User Instructions

ATTENTION!

Electrostatic sensitive GaAs FET amplifier

1. To prevent damage through static charge build up, cables should be always discharged before connecting them to the amplifier!
2. Attach a 50 Ohm output load before supplying DC power to the amplifier!
3. The supply voltage can be taken from any regular 6 V, 0.5 A DC power supply and can be connected to the supply feed-through filter via an ON / OFF switch.
4. Using a 3 dB or 6 dB input attenuator will result in a 6 dB or 12 dB increase of the input return loss. For minimal degradation of amplifier rise time, these attenuators should have a bandwidth specification of greater 50 GHz (V/ 1.85mm attenuators)!
5. A input signal of about 0.35 Vpp will produce output swing of about 6 Vpp.
6. Higher input voltages will drive the amplifier’s output stage into saturation, leading to waveform peak clipping.
7. Saturated output voltages can only be used without damage while the amplifier is connected to a 50 Ohm precision load with a VSWR of less than 1.2 or better than 20 dB return loss up to 40 GHz.
8. While using a reflective load the output voltage has to be reduced to a safe operating level according to the magnitudes of the reflections.
9. ATTENTION: At radio frequencies a capacitive load can be transformed to an inductive one through transmission lines! With an output stage driven into saturation this may lead to the immediate destruction of the amplifier (within a few ps)!
10. The input voltage should never be greater than 0.6 Vpp equivalent to 0 dBm input power.